

## **ECONOMIC VALUE OF GRASSLAND PRODUCTS**

*András Nábrádi<sup>1</sup>, László Kárpáti<sup>1</sup>*

### **INTRODUCTION**

There are several grassland products the economic values of those are unclear in several cases. Besides demonstrating the social benefits of grassland products, the objective of the present study is to present the value of their diverse forms of utilization and their definitions in practice. The study groups marketable and non-marketable grass products and introduces a new category, the animal husbandry value of grasses.

Besides several other factors, economists differ from researchers in other areas of science since they are basically motivated by three issues: the first question they always raise is: “What can it be used for?”, the second is: “What is it worth?” and the third is: “How can it (its value) be determined?” All the answers to any further questions are subordinated to these three ones.

### **BENEFITS OF GRASS**

Figure 1 presents the areas of grass utilization.

The more concrete forms of these areas of utilization are the following:

1. Animal nutrition
2. Health care, medicinal plants (herbs)
3. Soil protection
4. Nature and environmental protection, biodiversity
5. Pleasant human environment
6. Utilization for sports
7. Energetics
8. Business profitability

In the following part of the study let us see this key area of our topic: what grasses are worth and how it can be defined. In order to approach it an operations research method is applied, as below.

---

<sup>1</sup> András Nábrádi, László Kárpáti, University of Debrecen Faculty of Agricultural Economics and Rural Development

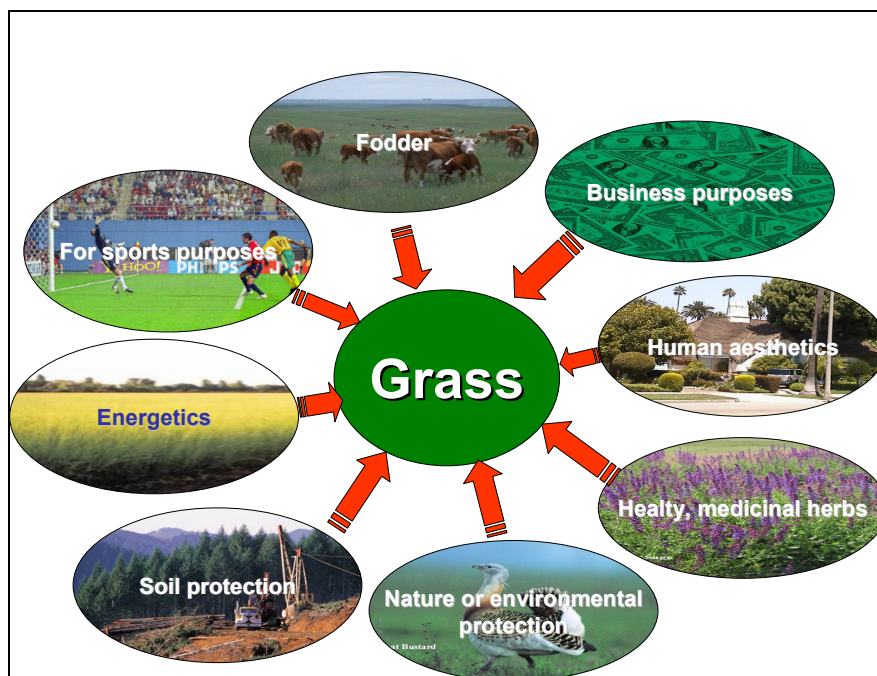


Figure 1 Areas of grass utilization

#### DETERMINATION OF THE FORAGE VALUE OF GRASS ON THE BASIS OF REPLACEMENT VALUE

Replacement value can be calculated if grasses substitute or supplement other forages. The basis of calculation in this event is the prices of replaced forages, considering their inner content and animals' nutrient needs. Logically, the calculation is quite simple. It answers the question, how much HUF/EUR value of other (marketable) forages grasses can replace or supplement through their inner content. Besides logical simplicity, the determination is much more complicated, as several elements are to be considered simultaneously. Determination is facilitated by linear programming long time well-known. In an LP model the following dependent and independent variables are to be taken into account:

- nutrient needs of animals
- nutrient content of forages
- biological and technological restricting factors,
- the volume of expectable alternative income,
- the nutrient content of grasses.

All these elements are affecting the complex economic value of a grass product for example the hay. The calculation of complex economic value is based on shadow price analysis.

Given a normal LP model:

$$\begin{aligned} x &\geq 0 \\ A_1 x &\leq b_1 \\ A_2 x &= b_2 \\ A_3 x &\geq b_3 \\ Z &= \sum_{j=1}^{n_1} x_j p_j \rightarrow \max. \end{aligned}$$

The solving matrix is the following:

	$x_1$	...	$x_i$	...	$x_n$	
$u_1$	$a_{11}$	...	$a_{1j}$	...	$a_{1n}$	$b_1$
$u_2$	$a_{21}$	...	$a_{2j}$	...	$a_{2n}$	$b_2$
$\vdots$	$\vdots$		$\vdots$		$\vdots$	
$u_i$	$a_{i1}$	...	$a_{ij}$	...	$a_{in}$	$b_i$
$\vdots$	$\vdots$		$\vdots$		$\vdots$	
$u_m$	$a_{m1}$	...	$a_{mj}$	...	$a_{mn}$	$b_m$
	$p_1$	...	$p_j$	...	$p_n$	$z$

$p_j > p_1, p_2, \dots, p_n$   
 $\frac{b_i}{a_{ij}} > \frac{b_1}{a_{1j}}, \frac{b_2}{a_{2j}}, \dots, \frac{b_m}{a_{mj}}$   
 $\tau = a_{ij}$

$\delta_1 = \frac{a_{1i}}{a_{ij}}, \delta_2 = \frac{a_{i2}}{a_{ij}}, \dots,$   
 $\delta_0 = \frac{b_i}{a_{ij}}$

After the first iteration the result is:

	$x_1$	$u_i$	$x_n$	
$u_1$	$a_{11} - \delta_1 a_{1j}$	$- \tau a_{1j}$	$a_{1m} - \delta_n a_{1j}$	$b_1 - \delta_0 a_{1j}$
$u_2$	$a_{21} - \delta_1 a_{2j}$	$- \tau a_{2j}$	$a_{2m} - \delta_n a_{2j}$	$b_2 - \delta_0 a_{2j}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$x_j$	$\delta_1$	$T$	$\delta_n$	$\delta_0$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$u_m$	$a_{m1} - \delta_1 a_{mj}$	$- \tau a_{mj}$	$a_{mn} - \delta_n a_{mj}$	$b_m - \delta_0 a_{mj}$
	$p_1 - \delta_1 p_j$	$- \tau p_j$	$p_n - \delta_n p_j$	$z - \delta_0 p_j$

As we can see, if the  $x_j$  variable inside the basis the  $x_j, x_n$  variables' shadow price can be formulated with formula of  $p_1 - \delta_1 p_j$ , or  $p_n - \delta_n p_j$ .

Let us assume that after the  $i^{th}$  iteration we get the optimum solution and the  $x_n$  source (variables) not get into optimal structure.

In that case the  $x_n$ 's shadow price :

$$p_{n_{i-1}} - \left( \delta_{n_i} \cdot p_{j_{i-1}} \right),$$

can be formulated, where :

$p_{n_{i-1}}$  = after the  $i-1$ -iteration the  $x_n$  sources' objective function

$\delta_{n_i}$  = after the  $i^{th}$  iteration the row of the generation element's  $n$ -type adequate

$p_{j_{i-1}}$  = after the  $i-1$  iteration the column of generation element's objective function.

How the  $x_n$  germane shadow price modified if we increase the objective function with  $L$  constant?

Unambiguous that  $x_n$  germane shadow price also modified by constant  $L$  because it's value is directly effected by the original objective function:

$$p_n \rightarrow p_n - \delta_n p_j \rightarrow p_{n_{i-1}} - \delta_{n_i} p_{j_{i-1}}$$

$$p_n + L \rightarrow p_n + L - \delta_n p_j \rightarrow p_{n_{i-1}} + L - \delta_{n_i} p_{j_{i-1}}$$

If we choose to the L constant the dual variable  $p_{n_{i-1}} - \delta_{n_i} p_{j_{i-1}}$  in that case the shadow price will be equal with 0 (zero) which means an alternative optimum solution.

If the

$$L \geq p_{n_{i-1}} - \delta_{n_i} p_{j_{i-1}},$$

than the variable  $x_n$  can also get into the basis. From this point to ensue that it can be define the initial  $x_n$  germane objective function value which above the variable can into the optimal structure. It can be reached that we add to the initial objective function the germane  $x_n$  variable's shadow price.

In the animal feeding LP models the objective function is the cost or area minimization. In that case the initial value of objective function and distinction of variable's (which not in the optimal solution) shadow price can show us the limit value in which under the variable can get into the optimal structure.

That is to say, an animal fodder which not in the optimal structure can be got into the optimal solution if it's initial objective function is:

$$p_n - \left( p_{n_{i-1}} - p_{j_{i-1}} \right)$$

less than the above distinction.

From this point is to ensue that if we want to know a fodder's limit price than the initial objective function should be increased to an extreme big value. It means, the fodder no chance to get into the optimal solution which means parallel that it has a shadow price, as well. The limit price can be determined by the distinction of extreme big value and the shadow price.

The value of objective function in a feeding LP model is differs depending on cost or area minimization. In a cost minimization the value of objective function is the price of the fodder (HUF/kg, or EUR/kg). At the area minimization the objective function value is the specific area demand of a fodder (m<sup>2</sup>/kg).

The limit price of the grass product is the distinction of the value of objective function and it's shadow price. The cost effect of a grass product ( $K_h$ ) shows the distinction of the limit price and factual price ( $P_{ne}$ ) of a grass product.

$$K_h = \left( p_{n_1} - p_{n_{i-1}} - \delta_{n_i} \cdot p_{j_{i-1}} \right) - p_{n_0}$$

$$K_h = \text{Limit price} - \text{Factual price (cost)}$$

The unit of the  $K_h$  is HUF/kg, or EUR/kg. If the value is positive, the grass product has fodder cost reducing impact, if negative, than fodder cost increasing effect. The affect of exemption areas of a grass product is the release value. To determine of release value can be calculated with similar method as limit price (cost), namely the release value ( $T_h$ ):

$$T_h = p_{n_1} - p_{n_{i-1}} - \delta_{n_i} \cdot p_{j_{i-1}}$$

$$T_h = \text{Grass objective function value} - \text{Grass shadow price}$$

The only difference compared to the cost effect is the divergence of the objective function value, namely the objective function value is the specific area demand of fodders ( $P_n$  unit is  $m^2/kg$ ).

After determining release value can be calculated the economic affect of exemption areas of a grass product.

The simple way for considering is to look an average (expected) income from field crops is, as below:

$$T_{ge} = T_h \cdot I$$

where:

$T_{ge}$  = economic affect of exemption areas of a grass product (Ft/kg or EUR/kg)

$T_h$  = release value of a grass product ( $m^2/kg$ )

$I$  = average field income (HUF/ $m^2$ , or EUR/ $m^2$ )

The amount of Complex Economic Value of grassland product is the sum of cost effect and economic affect of exemption areas ( $K_{ge_n}$ ).

$$K_{ge_n} = K_h + T_{ge}$$

All these factors are presented in *Figure 2*.

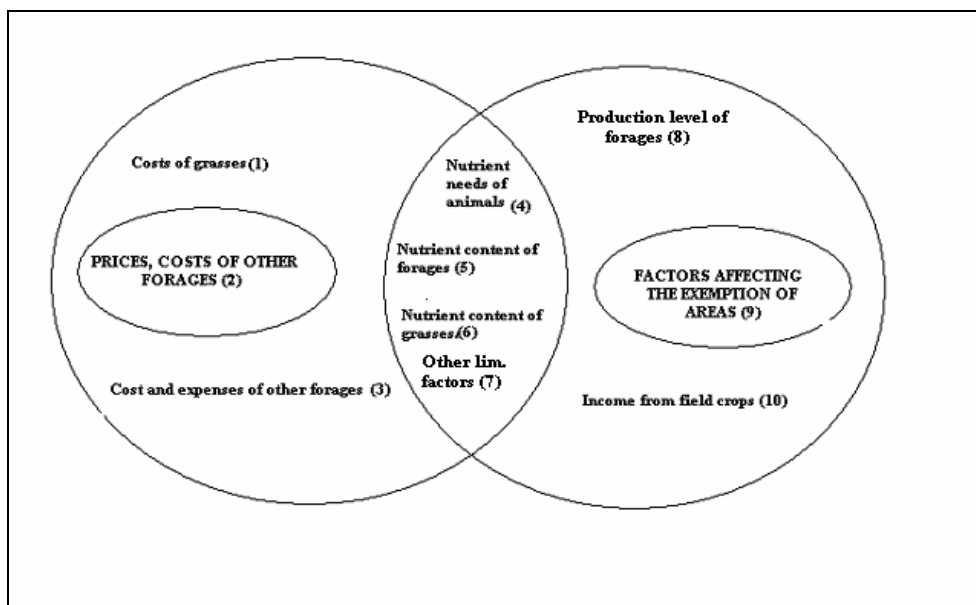


Figure 2 The feeding value of grasses

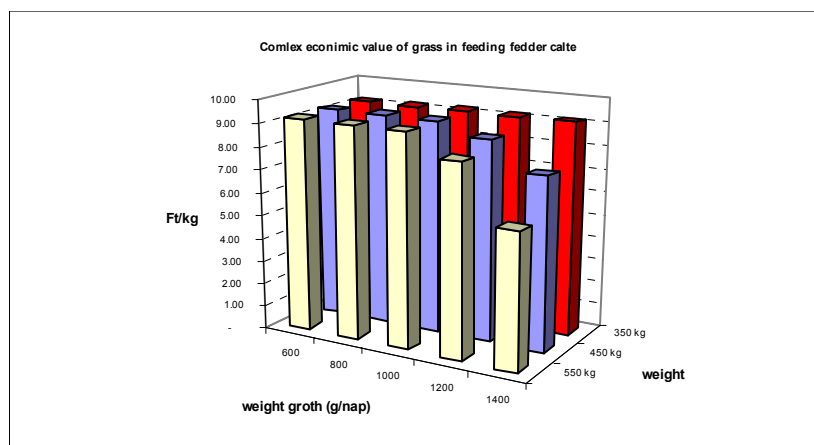


Figure 3 Complex economic value of grass in feeding cattle

We present the results of the two model calculations to determine the so-called economic value by the above mentioned method. In the first case the economic value of grasses was examined in the event of foraging ewes in three age groups, in

5 body mass categories. This is presented in Figure 3. It can be clearly seen that the nutrition needs of animals also influence the economic value, which varies in the range of 8.7-9.3 HUF/kg in for ewes (3-3,5 Eurocent).

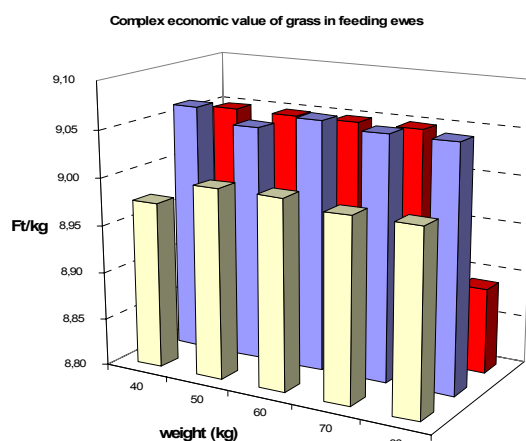


Figure 4 The complex economic value of grasses for grazing in feeding ewes and feeder cattle (on the basis of Szöllösi's calculations, 2004)

Legend: feeding ewes (1), weight (2), until 3-month pregnancy (3), until 3 month pregnancy (4), lactating ewes (5), beef cattle (6), weight gain (7)

The same calculation was performed for the for the forage portion model of finishing cattle in three body mass categories, taking 5 days' body mass growth into consideration. It can be seen that the **complex economic value** of **grasses** for grazing varies in the range of 4.8-9.0 HUF/kg in the event of feeding cattle (1,8-3.4 Eurocent)- (Figure 4).

The determination using replacement value has its evident advantages and disadvantages, as well. Its advantage is that it determines the economic value of grassland products relatively precisely, but for merely in the given animal species and way of utilization, for which the LP model was developed. Therefore, an exact price for further generalization cannot be determined either, and the economic value can only be expressed in intervals. A further hindrance of the method is that a linear programming model has to be developed, which is a complicated task for farmers in practice.



## CONCLUSION

As it was mentioned in the introduction of the present study, the animal husbandry value of grasslands, taking the above mentioned factors into consideration, is wide-ranging, complicated and complex. It is affected by feeding value related to grassland utilization, greater animal life performance, specific end-products due to the rich nutrient supplies of grasses, and last, but not least, the effects of provided subsidy, as well. On the basis of all these we can draw the conclusion that grasses as forages are worth much more than the value we can characterize by their inner content.

The study highlighted the fact that the survey of certain utilization potentials is far from being complex, although methods to explore them are available. However, several areas of utilization have not yet been explored, so there might be hidden potentials for grassland farmers and professionals of economics to work them out in details.

## REFERENCES

1. Jávor A. (1999): Juhok és a legelő (Sheep and grassland) Agrárökológia-Gyep-Vidékfejlesztés. Debreceni Gyepgazdálkodási Napok kiadványa. 173-176.p.
2. Jávor A.-Molnár Gy.-Kukovics S. (1999): Juhtartás összehangolása a legelővel. (Balancing sheep breeding with grassland) Agrárökológia-Gyep-Vidékfejlesztés. Debreceni Gyepgazdálkodási Napok kiadványa. 169-172.p.
3. Kátai J. (2004): Gyep-talaj kölcsönhatása. (Soil-grass interaction) A gyepgazdálkodás ökológiai kérdései, ökonómiai aspektusai. Az MTA Gyepgazdálkodási Bizottsága és a DE-ATC vitanapján elhangzott előadás. Debrecen, 2004. November 25. 1-27.p.
4. Lapis M. (2004): A gyepgazdálkodás és a gyephasznosítás ökonómiai kérdései. (Economic questions of grass utilization and grassland management) DE-AVK előadás. 1-34.p.
5. Marselek S. (1997): In Magda S.-Marselek S.-Miller Gy.-Gáspár F. Termelési folyamatok szervezése és ökonómiája. I-IV. (Organization and economics of agricultural technology). Phare távoktatási tankönyv, Gyöngyös
6. Molnár B.-Jávor A.-Molnár Gy.-Kukovics S. (1998): The optimal use of feedbase as the reserve of sheep production. Sheep and goat production in Central and Eastern European Countries. FAO, Rome, Reu Technical Series 50. 227-230.p.

7. Stefler J.-Vinczeff I. (1998): Környezet- és természetvédelmi igényeket is szolgáló extenzív állattartási rendszerek létrehozása. (Establishment of environmentally and ecologically friendly extensive type animal production system) In: Lehetőségek az agrártermelés környezetberát fejlesztésében. Stratégiai kutatások. MTA.
8. Széles Gy. (2001): A gyepgazdálkodás szervezése és ökonómiája. (The grassland management and economics) In: Pfau E.-Széles Gy. Mezőgazdasági üzemtan II., Mezőgazdasági Szaktudás Kiadó, Budapest, p.293-300.